GEOTECHNICS PTY LTD
CONSULTING GEOTECHNICAL ENGINEERS

ACID SULFATE SOILS MANAGEMENT PLAN

FOR

NSW LAND & HOUSING CORPORATION

38-44 John T Bell Drive & 31-35 Matfen Close, Maryland, New South Wales (BGWY7)

Report No: 22/2797

Project No: 30615/6756D-G

August 2022

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1. INTRODUCTION

This report details an Acid Sulfate Soil Management Plan (ASSMP) prepared by STS Geotechnics Pty Limited (STS) for a proposed residential construction at 38-44 John T Bell Dri ve and 31-35 Matfen Close, Maryland. The report has been prepared to assist with m anagement of acid sulfate soils (ASS) during the proposed development works. The N ewcastle City LEP indicates that the site is located within a Class 2 Acid Sulfate Soils area.

In Class 2 areas assessment and management is required if either of the following apply:

- Works below the existing ground surface
- Works by which the water table is likely to be lowered.

The following documents were used in the preparation of the ASSMP.

- The results of a Geotechnical Investigation and ASS Assessment undertaken by STS referenced Report No. 20/3519 and dated October 2022. This previous report should be read in conjunction with this ASSMP.
- Architectural drawings by CKDS Architects referenced Project No. dated 21/7/2022, Drawing Nos. A-0001 to A-0004, A-0101, A-1001 to A-1003, A-1101 to A-1106, A-2001 to A-2003, A-3001 & A-3002, A-4001 TO A-4001 TO A-4003, A-5001 TO A-5003, A-6001 & A-6002 and A-7001.

Based on the drawings the proposed works comprise the demolition of the existing buildings and the construction of a double-storey residential development without basement parking. Drawing A-4001, Cut & Fill Diagram shows that there is no cut, only filling as part of the site works. The depth of filling appears to be up to about 0.3 metres.

The objective of this ASSMP is to provide the framework for the management and monitoring of the impacts of Acid Sulfate Soils (ASS), throughout the construction and operation phases of the project, in accordance with the *Acid Sulfate Soils Manual* (ASSMAC, 1998).

To achieve the above objectives, the scopes of works are as follows:

- A description of the potential impacts caused by the proposed construction activities.
- A description of the measures and procedures to be undertaken in the ASS area which when implemented will prevent, control, or minimise the generation or escape of acid leachate into the surrounding environment.
- A focussed monitoring program covering soils, surface waters, and groundwater.

- A description of the contingency procedures to be implemented in the case of failure of management procedures; and
- A record of consultation with co-ordinating authorities.

Our scope of work did not include a contamination assessment of the site.

2. POTENTIAL ENVIRONMENTAL IMPACTS

Soils identified as ASS will require appropriate management to minimise environmental impacts that are likely caused by soil and groundwater disturbance during the construction activities.

Soil management options commonly adopted for ASS comprise:

- Avoidance, or minimisation of ASS disturbance.
- Soil neutralisation (typically with lime).
- Strategic reburial under water.
- Off-site ASS treatment and disposal.

The following issues will need to be considered during construction in a potential ASS environment:

- Exposure and oxidation of excavated (stockpiled) material and generation of acid leachate.
- Release of acidic surface and groundwater(s) during the excavation; and
- Ongoing oxidation of excess ASS generated by excavations and consequential generation of acidic groundwater.

The extent of any associated adverse impacts will depend on the following factors:

- Volume of excavated soil identified as being ASS.
- Physical characteristics of the ASS, such as grain size and natural buffering capacity.
- Time that ASS is exposed to air; and
- Rate of oxidation and transport of the oxidation products.

Effective control of these potential impacts will ensure there is no incremental contribution of acid leachates during construction.

All disturbed ASS should either be neutralised and disposed off-site to a licensed facility or disposed to a licensed waste handling facility and placed below the water table. Management and treatment requirements are further discussed in below. No ASS should be

used for structural or general filling above the groundwater table without prior neutralisation and validation of successful neutralisation.

Inadequate identification, management, and monitoring will result in detectable incremental impacts. Many aquatic and marine organisms are extremely sensitive to acid drainage; as a result, the acid leachates released may have serious environmental impacts including:

- Aluminium and iron dissolved in acid leachates can be poisonous to both aquatic and terrestrial life forms.
- Sulfate salts released can increase the salinity of freshwater; and
- Acidic sediment may "fix" phosphates and other nutrients which prevents their uptake by plants.

3. SUBSURFACE CONDITIONS AND FOUNDATION CONSTRUCTION

The earlier STS report noted that the subsurface conditions consist of topsoil/fill overlying fill, silty sandy clays and silty clays. Topsoil/fill was encountered to depths of 0.1 to 0.3 metres. Silty clay fill underlies the site to depths of 1.2 and 1.9 metres. For the most part, this material seems to be firm to stiff and stiff. Natural silty clays underlie the fill to the depth of drilling, 3.0 metres. The consistency of these materials range between soft to firm and very stiff.

Groundwater was not observed during drilling of the boreholes, however, some moist to wet zones were noted.

The borehole locations are shown on Drawing No. 20/3519. This drawing and the borehole logs from the previous investigation are given in Appendix A.

The earlier STS report notes that the existing fill materials should not be relied upon for foundation support unless written confirmation is obtained confirming that fill was placed in a controlled manner and recommended pile founded in stiff and very stiff natural materials may be used for support. If screw piers are used for foundation support, no lower soil will come to the surface, however, if conventional augered cast in place piers are used lower soils will be excavated and exposed to the atmosphere.

4. ACID SULFATE SOIL CONSIDERATION

To assess the significance of the PASS, eight (8) samples were sent to a NATA accredited laboratory for Suspension Peroxide Oxidation Combined Acidity and Sulfur (SPOCAS) testing.

STS have assumed that excavation is limited pier and trench excavations and estimates that less than 1000m^3 of material will be removed for the site.

The test results were compared to action criteria for 1-1000 tonnes of potential ASS disturbed material, as referenced in NSW Acid Sulfate Soil Management Advisory Committee, Acid Sulfate Soil Manual (ASSMAC,1998) summarised in Table 4.1.

The action criteria trigger needed to prepare an ASSMP and are based on the percentage of oxidisable sulphur (or equivalent TPA and TSA) for broad categories of soil types. Works in soils that exceed these action criteria must prepare a management plan and obtain development consent.

As the soils encountered on the site primarily consisted of clays, the fine texture grade (FT) criteria are the most appropriate and have been adopted for this assessment The laboratory results are summarised in Table 4.2 with the complete test results given in Appendix B.

The action criteria trigger needed to prepare an ASSMP and are based on the percentage of oxidisable sulphur (or equivalent TPA and TSA) for broad categories of soil types. Works in soils that exceed these action criteria require a management plan and obtain development consent.

Table 4.1 – ASS Action Criteria

Type of material		**Action Criteria if 1-1000 tonnes PASS disturbed**		**Action Criteria if more than 1000 tonnes PASS disturbed**	
Texture Range (McDonald et al 1990)	**Approx. clay content (%<0.02mm)**	**Sulphur Trail %S oxidisable (oven dry basis) eg S_{TOS} or S_{POS}**	**Acid Trail Mol H^+/tonne (oven dry basis) eg TPA or TSA_S**	**Sulphur Trail %S oxidisable (oven dry basis) eg S_{TOS} or S_{POS}**	**Acid Trail Mol H^+/tonne (oven dry basis) eg TPA or TSA_S**
Coarse Texture (CT) Sands to loamy sands	≤5	0.03	18	0.03	18
Medium Texture (MT) Sandy loams to light clays	5-50	0.06	36	0.03	18
Fine Texture (FT) Medium to heavy clays and silty clays	≥50	0.1	62	0.03	18

Table 4.2 – SPOCAS TEST RESULTS SUMMARY

Analysis	Unit	LOR	ASS1 BH1 @ 0.5m	ASS2 BH1 @ 1.0m	ASS3 BH1 @ 1.5m	ASS4 BH1 @ 2.0m	Action Criteria[1] <1000 tonnes disturbed
pH before Oxidation	NA	0.1	4.2	5.8	4.6	4.5	-
pH after Oxidation	NA	0.1	4.4	7.0	4.1	4.5	<3 (high risk)
S (POS)	%	0.02	0.052	0.035	0.031	0.048	0.1
TPA	mole/tonne	2	101	<2	100	136	62
TSA	mole/tonne	2	43	<2	75	88	62

[1] = ASSMAC (1998)

Action Criteria Exceeded

Table 4.2 – SPOCAS TEST RESULTS SUMMARY (Cont.)

Analysis	Unit	LOR	ASS5 BH1 @ 3.0m	ASS6 BH5 @ 0.5m	ASS7 BH5 @ 1.0m	ASS8 BH8 @ 2.5m	Action Criteria[1] <1000 tonnes disturbed
pH before Oxidation	NA	0.1	4.0	4.8	4.7	5.2	-
pH after Oxidation	NA	0.1	4.1	4.6	4.3	4.9	<3 (high risk)
S (POS)	%	0.02	<0.02	<0.02	<0.002	0.051	0.1
TPA	mole/tonne	2	180	11	91	42	62
TSA	mole/tonne	2	88	<2	68	31	62

[1] = ASSMAC (1998)

Action Criteria Exceeded

5. DISPOSAL OF POTENTIAL ACID SULFATE SOILS BELOW THE WATER TABLE

In accordance with the EPA (2014) *Waste Classification Guidelines Part 4: Acid Sulfate Soils*, any potential ASS encountered on this site may be disposed of in water below the permanent water table, provided:

- This occurs before they have had a chance to oxidise, i.e. within 24 hours of excavation;
- They meet the definition of 'virgin excavated natural material' (VENM) under the *Protection of the Environment Operations Act 1997*, even though they contain sulfidic ores or soils; and
- Landfills must be licensed by NSW EPA to dispose of potential ASS below the water table.

Potential ASS must be disposed of within 8 hours of their receipt at a landfill and always kept wet until their burial at least 2.0 metres below the lowest historical level of the water table at the disposal site. It is understood that PASS shall be disposed below the water table at the receiving landfill facility, as required.

5.1. Process for Excavation of PASS

Excavation shall proceed in stages, as follows:

- Any surface topsoil shall be stripped and removed, and care must be taken to ensure that no surface topsoil is mixed with any PASS material below.
- The sides of pipe trenches shall also be stripped a further 200 mm laterally to ensure potential surface soils do not fall into the pit and cross contaminate with any PASS materials below.
- PASS materials shall be excavated to the required depth and loaded directly onto waiting trucks. Each truckload shall be inspected and verification testing for pH shall be carried out to confirm soil pH does not fall below pH 5.5 prior to leaving the site; and
- Verification testing is required to demonstrate that materials with existing acidity are not being reburied. Should field pH fall below pH 5.5, the materials from that truck are to remain on-site and lime neutralisation techniques are to be implemented, as discussed below.

5.2. Transportation

Transport of PASS material to the receiving landfill facility shall take place immediately. If this is not possible, PASS soils shall be stockpiled and immediately covered. Stockpiled PASS materials must leave the site within 12 hours of excavation otherwise lime neutralisation techniques shall proceed as discussed below.

5.3. Documentation

Documentation must be provided to the occupier of the landfill for each truckload of PASS received, indicating that the soil excavation, transport, and handling have been in accordance with ASSMAC (1998), thus preventing the generation of acid.

The occupier of the disposal site must also test the pH of each load of soil received immediately prior to its placement under water using the test method(s) in ASSMAC (1998) (Methods 21A and/or 21AF). These details, together with the pH of the soil recorded at the time of its extraction, must be retained by the occupier of the landfill site.

Soil that has dried out, undergone any oxidation of its sulfidic minerals, or which has a pH of less than pH 5.5 must be treated by neutralisation and disposed of at a landfill that can lawfully accept it.

The pH of the water at the landfill into which the potential ASS is placed must not be less than pH 5.5 at any time. Landfill licence conditions require the occupiers of potential ASS disposal sites to regularly monitor the pH of ground and surface waters at their premises.

6. DISPOSAL OF POTENTIAL ACID SULFATE SOILS ABOVE THE WATER TABLE

The total volume of PASS to be excavated or disturbed during construction shall be stockpiled separately within designated areas and treated (limed) immediately. More specifically, the management procedures are:

- For treatment of large volumes of material by mechanical application of neutralisation materials, treatment should be carried out on a treatment pad, with adequate sediment erosion control measures in place.

- Excavated PASS shall be stockpiled upon the treatment pad area. The treatment pad should consist of a minimum 300 mm thickness of compacted crushed limestone, or other appropriate neutralisation material. The level of compaction used should produce an appropriately low permeability base to prevent infiltration of leachate. The treatment pad should be bunded with a minimum 150 mm high perimeter of compacted, crushed limestone to contain potential leachate runoff within the treatment pad area and prevent surface water runoff from entering the treatment pad area. Lime shall be spread evenly upon the excavated materials, and thoroughly mixed; and

- Following treatment, soils should be chemically assessed, and waste classified for offsite disposal in accordance with the EPA (2014) *Waste Classification Guidelines*.

In addition, the following management strategies shall also be considered and implemented, as required, to manage risk:

- Installation of leachate collection and treatment systems.
- Construction of supplementary erosion and sediment control structures.

If lime treatment on freshly excavated PASS cannot be performed immediately, plastic sheeting shall be placed over the stockpile to reduce oxidation, and the following shall be adopted:

- For every day a stockpile remains on-site, representative samples will be monitored for pH; where pH falls below pH 5.5, lime will be applied for neutralisation purposes; and
- On-site neutralisation of acidic soils (<pH 5.5) will be carried out using powdered, agricultural lime.

6.1. Lime Requirement

Based laboratory test results, if neutralisation is required, the maximum liming rate required is 10kg/tonne.

6.2. Method of Neutralisation

To facilitate mixing, the soils should be thinly spread (<0.5 m). Lime should be added by hand and/or excavator bucket, followed by mixing using light-weight rotators and/or shovels.

Field pH testing on representative samples should be performed to ensure that sufficient neutralisation has occurred (i.e., pH is >pH 5.5), prior to disposal.

7. MANAGEMENT OF IN-SITU ACID SULFATE SOILS

Potential ASS which becomes exposed (oxidised) on excavation surfaces may produce acid. This corresponds to the soils below the depth of about 0.5 metres. For every day that such an excavated surface is in an exposed state, pH values shall be monitored from representative samples. Where soil pH levels fall below pH 5.5, lime will be applied to the potential ASS horizon(s) following the methodology presented below. Plastic sheeting can be placed over the corresponding surface (where possible) to reduce the oxidation rate.

8. GROUNDWATER MANAGEMENT AND DISPOSAL

8.1. Groundwater Management

No groundwater was encountered and therefore should require management. In the unlikely event groundwater is encountered the procedures outlined below are to be adopted.

The removal (pumping) of any groundwater from an excavation area may cause alterations to the existing groundwater table. Extracted groundwater should be pumped to a holding vessel for assessment of pH characteristics during the dewatering process. Extracted water should be treated with hydrated lime to display a pH level of pH 6-8, prior to off-site disposal. Powdered agricultural lime should be added to the water by hand and/or excavator bucket and mixed. Field pH testing on representative samples should be performed to ensure that sufficient neutralisation has occurred, prior to disposal.

In addition to the above, an appropriately designed truck wash area will be required to capture liquids and solids generated, prior to vehicles exiting the site. Treatment and neutralisation of solids and liquids shall be in accordance with that noted and above.

8.2. Groundwater Disposal

It is anticipated that extracted groundwater from the dewatering process will be disposed to the municipal stormwater system. Any permits / licences from Council and Water NSW shall be obtained prior to discharging to the municipal stormwater system.

Water for disposal will be tested routinely (weekly intervals) for the duration of dewatering activities, to ensure that no change to the quality of water entering the stormwater system, with the results made available to Council or Water NSW on request. Should it be found that groundwater quality is not suitable for disposal to the stormwater system, groundwater treatment or a Sydney Water permit to dispose to sewer shall be required prior to disposal.

Water quality monitoring for disposal to the municipal stormwater system shall include the following:

- Daily monitoring of field parameters (pH, electrical conductivity, dissolved oxygen, temperature, and turbidity) in the treated discharge water using data logging equipment.

- Weekly sampling and laboratory analysis of treated groundwater water for a range of relevant analytical parameters (i.e. to be specified in the Dewatering Management Plan). Laboratory results should be compared to freshwater trigger values provided in Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018) for slightly - moderately disturbed systems to provide a 95% level of species protection. Weekly sampling shall be performed by a suitably qualified Environmental Consultant and submitted to a NATA accredited laboratory for analysis of the above parameters, depending on the time frame required to complete the works.

9. CONTINGENCY PLANNING

A contingency plan is detailed below in Table 9.1. The plan provides a list of potential events that may arise during bulk excavation and the actions to be undertaken if unexpected conditions occur.

Table 9.1 Contingency Plan

Unexpected Condition	Action
Potential ASS identified at unexpected depths	Stop excavations. Have material assess by an environmental consultant for the presence of ASS; and Follow management procedures adopted in the ASSMP.
Neutralisation of ASS was not effective	Re-assess liming rates and add additional lime to material; and Re-test material to check neutralisation.
Neutralisation of ASS indicates that too much lime has been added and soils are alkaline	Remediate soils before use. Remediation comprises mixing additional ASS with the material, i.e. use excess lime to neutralise more ASS; and Re-test material to check neutralisation.
Bunded PASS treatment area is damaged	Repair bund as soon as practicable. Clean-up any PASS that escaped the treatment area and place back into the treatment area; and Check surrounding area for impact from the PASS or leachate, and undertake remedial action as required.
Groundwater level falls below the top of areas defined as containing PASS	Stop dewatering. Review PASS exposure by checking the ASS and Non-ASS interface in the affected area. Determine potential causes by reviewing construction practises, weather, baseline groundwater monitoring data, and performing additional groundwater monitoring as necessary on groundwater monitoring present at the site. Review and confirm mitigation measures to be implemented, including: Maintain PASS soil moisture levels through targeted groundwater recharge. Adjusting the construction activities or schedule; and Treatment of additional PASS in treatment area.

10. MONITORING PROGRAM

A small water collection point is to be installed at the lowest point of the property downhill of the area being excavated. This collection point can be simply a hole dug in the ground and a plastic container placed in the hole. After the first rainfall event the water collected in the container is to be tested to ensure its pH value is greater than 5.5.

11. STATEMENT OF LIMITATIONS

The findings presented in this plan are derived from previous site investigations. Due to the nature of borehole drilling, it is considered likely that all variations in subsurface conditions across a site cannot be fully defined, no matter how comprehensive the field investigation program, particularly on a site that has been previously developed.

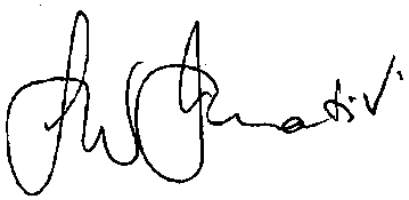
While normal assessments of data reliability have been made, STS assumes no responsibility or liability for errors in any data obtained from previous assessments conducted on site, regulatory agencies (e.g. Council, EPA), statements from sources outside of STS, or developments resulting from situations outside the scope of works of this project.

Despite all reasonable care and diligence, the ground conditions encountered, they may not be representative of conditions between the locations drilled. In addition, site characteristics may change at any time in response to variations in natural conditions, chemical reactions and other events (e.g. groundwater movement and/or spillages of contaminating substances). These changes may occur after STS's investigations and assessment.

Neither STS, nor any other reputable consultant, can provide unqualified warranties nor does STS assume any liability for site conditions not observed or accessible during the time of the investigations.

This plan was prepared for the above-named client and no responsibility is accepted for use of any part of this report in any other context or for any other purpose or by other third parties. This report does not purport to provide legal advice.

This plan and associated documents remain the property of STS subject to payment of all fees due for this assessment. The plan shall not be reproduced except in full and with prior written permission by STS.



Laurie Ihnativ
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STS Geotechnics Pty Limited

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APPENDIX A – DRAWING 20/3519, BOREHOLE LOGS AND EXPLANATION SHEETS

STS Geotechnics Pty. Ltd.	Scale: Unknown	Date: October 2020
Client: NSW LAND & HOUSING CORPORATION C/- SMEC AUSTRALIA		
GEOTECHNICAL INVESTIGATION—38-44 JOHN T BELL DRIVE AND 31-35 MATFEN CLOSE, MARYLAND **BOREHOLE AND PENETROMETER LOCATIONS**	Project No. 30615/4133D-G	
	Drawing No: 20/3519	

STS Geotechnics Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: NSW Land & Housing Corporation C/- SMEC Australia		Project / STS No. 30615/4133D-G	**BOREHOLE NO.: BH 1**
Project: 38-44 John T Bell Drive and 31-35 Matfen Close, Maryland		Date: October 1, 2020	
Location: Refer to Drawing No. 20/3519		Logged: JK Checked By: SS	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
			FILL: SILTY CLAY: light brown, medium plasticity	CL	SOFT TO FIRM	M
	S1 @ 0.4 m		FILL: SILTY CLAY: mottled orange brown, light grey and dark grey, medium to high plasticity	CL/CH	GENERALLY STIFF	M
	ASS1 @ 0.5 m	0.5				
	U50 0.6-0.85 m					
	ASS2 @ 1.0 m	1.0				
	U50 1.4-1.65 m		SILTY CLAY: dark grey with occasional orange brown, medium to high plasticity	CL/CH	FIRM TO STIFF	M
	ASS3 @ 1.5 m	1.5				
					VERY STIFF	
	ASS4 @ 2.0 m	2.0				
		2.5	SILTY CLAY: light grey with orange brown, high plasticity	CH	VERY STIFF	M
	ASS5 @ 3.0 m		BOREHOLE DISCONTINUED AT 3.0 M ON SILTY CLAY			

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS

Equipment: Mini Christie

Hole Diameter (mm): 100

Angle from Vertical (°): 0

Drill Bit: Spiral

STS Geotechnics Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: NSW Land & Housing Corporation C/- SMEC Australia	Project / STS No. 30615/4133D-G	**BOREHOLE NO.: BH 2**
Project: 38-44 John T Bell Drive and 31-35 Matfen Close, Maryland	Date: October 1, 2020	
Location: Refer to Drawing No. 20/3519	Logged: JK Checked By: SS	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
			FILL: SILTY CLAY: light brown, low plasticity	CL	SOFT	M
			FILL: SILTY CLAY: mottled orange brown, light grey, dark grey and yellow brown, medium to high plasticity, trace of gravel	CL/CH	SOFT TO FIRM	M
		0.5			GENERALLY FIRM TO STIFF	
		1.0				
		1.5				
			SILTY CLAY: light grey with dark grey and orange brown, high plasticity, occasional organic matter	CH	FIRM TO STIFF	M
		2.0				
					STIFF	
		2.5				
			BOREHOLE DISCONTINUED AT 3.0 M ON SILTY CLAY			

D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)
S - jar sample

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Mini Christie
Hole Diameter (mm): 100
Angle from Vertical (°): 0
Drill Bit: Spiral

STS Geotechnics Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: NSW Land & Housing Corporation C/- SMEC Australia	Project / STS No. 30615/4133D-G	**BOREHOLE NO.: BH 3**
Project: 38-44 John T Bell Drive and 31-35 Matfen Close, Maryland	Date: October 1, 2020	
Location: Refer to Drawing No. 20/3519	Logged: JK Checked By: SS	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
			FILL: SILTY CLAY: light brown, medium plasticity	CL	SOFT TO FIRM	D-M
	S2 @ 0.4 m	0.5	FILL: SILTY CLAY: mottled light grey, orange brown, yellow brown and dark grey, medium to high plasticity	CL/CH	GENERALLY STIFF	D-M
		1.0				
		1.5	SILTY CLAY: dark grey, medium to high plasticity	CL/CH	FIRM TO STIFF	M
		2.0			STIFF	
		2.5				
			BOREHOLE DISCONTINUED AT 3.0 M ON SILTY CLAY			

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS

Equipment: Mini Christie

Hole Diameter (mm): 100

Angle from Vertical (°): 0

Drill Bit: Spiral

STS Geotechnics Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: NSW Land & Housing Corporation C/- SMEC Australia	Project / STS No. 30615/4133D-G	**BOREHOLE NO.: BH 4**
Project: 38-44 John T Bell Drive and 31-35 Matfen Close, Maryland	Date: October 1, 2020	
Location: Refer to Drawing No. 20/3519	Logged: JK Checked By: SS	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
			FILL: SILTY SANDY CLAY: light brown, fine grained, low plasticity	CL	FIRM TO STIFF	D-M
	S3 @ 0.3 m	0.5	FILL: SILTY CLAY: mottled orange brown, light grey, yellow brown and dark grey, medium to high plasticity	CL/CH	GENERALLY FIRM TO STIFF	D-M
	U50					
		1.0				
		1.5	SILTY CLAY: dark grey, high plasticity	CH	STIFF	M
					VERY STIFF	
		2.0				
		2.5				
			BOREHOLE DISCONTINUED AT 3.0 M ON SILTY CLAY			

D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)
S - jar sample

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Mini Christie
Hole Diameter (mm): 100
Angle from Vertical (°): 0
Drill Bit: Spiral

STS Geotechnics Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: NSW Land & Housing Corporation C/- SMEC Australia	Project / STS No. 30615/4133D-G	**BOREHOLE NO.:**	**BH 5**
Project: 38-44 John T Bell Drive and 31-35 Matfen Close, Maryland	Date: October 1, 2020		
Location: Refer to Drawing No. 20/3519	Logged: JK Checked By: SS	Sheet 1 of 1	

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
			FILL: SILTY CLAY: dark brown, medium plasticity, trace of fine sand	CL	SOFT TO FIRM	M
	S4 @ 0.4 m ASS6 @ 0.5 m	0.5	FILL: SILTY CLAY: mottled light grey with orange brown and yellow brown and dark grey, medium to high plasticity, trace of fine sand	CL/CH	GENERALLY FIMR TO STIFF AND STIFF	M
	ASS7 @ 1.0 m U50 1.0-1.3 m	1.0				M-W
		1.5	SILTY SANDY CLAY: dark grey, fine grained, medium plasticity	CL	SOFT TO FIRM	M-W
		2.0				
	ASS8 @ 2.5 m	2.5	SILTY CLAY: orange brown with light grey, medium to high plasticity	CL/CH	FIRM TO STIFF VERY STIFF	M
			BOREHOLE DISCONTINUED AT 3.0 M ON SILTY CLAY			

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS

Equipment: Mini Christie

Hole Diameter (mm): 100

Angle from Vertical (°): 0

Drill Bit: Spiral

STS Geotechnics Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: NSW Land & Housing Corporation C/- SMEC Australia	Project / STS No. 30615/4133D-G	**BOREHOLE NO.:**	**BH 6**
Project: 38-44 John T Bell Drive and 31-35 Matfen Close, Maryland	Date: October 1, 2020		
Location: Refer to Drawing No. 20/3519	Logged: JK Checked By: SS	Sheet 1 of 1	

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
			FILL: SILTY CLAY: dark brown, medium plasticity	CL	SOFT TO FIRM	M
			FILL: SILTY CLAY: mottled orange brown, light grey, yellow brown and dark grey, medium to high plasticity	CL/CH	GENERALLY VERY STIFF	M
		0.5				
		1.0				
			SILTY SANDY CLAY: light grey with orange brown, fine grained, medium to high plasticity	CL/CH	STIFF	M
		1.5			VERY STIFF	
		2.0				
		2.5				M-W
			BOREHOLE DISCONTINUED AT 3.0 M ON SILTY SANDY CLAY			

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS

Equipment: Mini Christie

Hole Diameter (mm): 100

Angle from Vertical (°): 0

Drill Bit: Spiral

STS Geotechnics Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: NSW Land & Housing Corporation C/- SMEC Australia		Project / STS No. 30615/4133D-G	**BOREHOLE NO.: BH 7**
Project: 38-44 John T Bell Drive and 31-35 Matfen Close, Maryland		Date: October 1, 2020	
Location: Refer to Drawing No. 20/3519		Logged: JK Checked By: SS	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
			TOPSOIL: SILTY CLAY: dark brown, medium plasticity	CL	SOFT TO FIRM	M
	S5 @ 0.3 m U50 0.5-0.7 m	0.5	FILL: SILTY CLAY: mottled light grey, light brown, orange brown and yellow brown, medium to high plasticity, trace of gravel	CL/CH	GENERALLY FIRM TO STIFF	M
		1.0				
		1.5				
			SILTY CLAY: dark grey, medium to high plasticity	CL/CH	STIFF TO VERY STIFF	M
		2.0			VERY STIFF	
		2.5				
			SILTY CLAY: orange brown with light grey, medium to high plasticity	CL/CH	VERY STIFF	M
			BOREHOLE DISCONTINUED AT 3.0 M ON SILTY CLAY			

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS

Equipment: Mini Christie

Hole Diameter (mm): 100

Angle from Vertical (°): 0

Drill Bit: Spiral

STS Geotechnics Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: NSW Land & Housing Corporation C/- SMEC Australia		Project / STS No. 30615/4133D-G	**BOREHOLE NO.: BH 8**
Project: 38-44 John T Bell Drive and 31-35 Matfen Close, Maryland		Date: October 1, 2020	
Location: Refer to Drawing No. 20/3519		Logged: JK Checked By: SS	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
			FILL: SILTY CLAY: dark brown, medium plasticity	CL	SOFT TO FIRM	M
	S6 @ 0.4 m U50 0.5-0.68 m	0.5	FILL: SILTY CLAY: mottled orange brown, light grey, light brown and dark grey, medium to high plasticity	CL/CH	GENERALLY FIRM TO STIFF AND STIFF	M
	U50 1.4-1.7 m	1.0 1.5				
		2.0	SILTY CLAY: dark grey, medium to high plasticity, trace of fine sand	CL/CH	STIFF	M-W
		2.5			VERY STIFF	
			BOREHOLE DISCONTINUED AT 3.0 M ON SILTY CLAY			

D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)
S - jar sample

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Mini Christie
Hole Diameter (mm): 100
Angle from Vertical (°): 0
Drill Bit: Spiral

STS Geotechnics Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: NSW Land & Housing Corporation C/- SMEC Australia	Project / STS No. 30615/4133D-G	**BOREHOLE NO.: BH 9**
Project: 38-44 John T Bell Drive and 31-35 Matfen Close, Maryland	Date: October 1, 2020	
Location: Refer to Drawing No. 20/3519	Logged: JK Checked By: SS	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
			FILL: SILTY CLAY: dark brown, medium plasticity	CL	SOFT TO FIRM	M
	S7 @ 0.3 m	0.5	FILL: SILTY CLAY: mottled orange brown, light grey, light brown and dark grey, medium to high plasticity	CL/CH	GENERALLYT FIRM TO STIFF AND STIFF	M
		1.0				
		1.5				
		2.0	SILTY CLAY: dark grey, medium to high plasticity	CL/CH	FIRM TO STIFF	M
		2.5			STIFF TO VERY STIFF	
			BOREHOLE DISCONTINUED AT 3.0 M ON SILTY CLAY		VERY STIFF	

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS

Equipment: Mini Christie

Hole Diameter (mm): 100

Angle from Vertical (°): 0

Drill Bit: Spiral

STS Geotechnics Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 | Email: enquiries@stsgeo.com.au

GEOTECHNICS PTY LTD
CONSULTING GEOTECHNICAL ENGINEERS

Dynamic Cone Penetrometer Test Report

Project: 38-44 JOHN T BELL DRIVE & 31-35 MATFEN CLOSE, MARYLAND
Client: NSW LAND & HOUSING CORPORATION C/- SMEC AUSTRALIA
Address: 20 Berry Street, North Sydney
Test Method: AS 1289.6.3.2

Project No.: 30615/4133D
Report No.: 20/3519
Report Date: 12/10/2020
Page: 1 of 2

NATA
Accredited for compliance with ISO/IEC 17025 - Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards
NATA Accreditation Number 2750

Site No.	P1	P2	P3	P4	P5	P6
Location	Refer to Drawing No. 20/3519	Refer to Drawing No. 20/3519	Refer to Drawing No. 20/3519	Refer to Drawing No. 20/3519	Refer to Drawing No. 20/3519	Refer to Drawing No. 20/3519
Date Tested	1/10/2020	1/10/2020	1/10/2020	1/10/2020	1/10/2020	1/10/2020
Starting Level	Surface Level	Surface Level	Surface Level	Surface Level	Surface Level	Surface Level
Depth (m)	Penetration Resistance (blows / 150mm)					
0.00 - 0.15	1	1	1	1	1	1
0.15 - 0.30	2	2	2	3	3	2
0.30 - 0.45	4	2	4	4	4	3
0.45 - 0.60	2	4	4	2	3	3
0.60 - 0.75	3	5	5	3	5	3
0.75 - 0.90	5	5	6	3	5	4
0.90 - 1.05	5	4	7	3	6	3
1.05 - 1.20	7	4	7	3	4	4
1.20 - 1.35	7	6	6	3	4	4
1.35 - 1.50	5	6	6	5	3	5
1.50 - 1.65	5	7	3	5	2	6
1.65 - 1.80	4	6	3	7	2	9
1.80 - 1.95	7	4	4	10	2	9
1.95 - 2.10	11	4	4	12	2	16
2.10 - 2.25	13	3	5	14	2	16
2.25 - 2.40	15	4	6	15	4	18
2.40 - 2.55	17	5	6	15	8	22
2.55 - 2.70	19	5	4	16	10	Refusal
2.70 - 2.85	22	6	5	16	10	
2.85 - 3.00	Refusal	8	5	17	11	
3.00 - 3.15		Discontinued	Discontinued	Discontinued	Discontunued	
3.15 - 3.30						
3.30 - 3.45						
3.45 - 3.60						
3.60 - 3.75						

Remarks: * Pre drilled prior to testing

Approved Signatory.....
Technician: JK
Orlando Mendoza - Laboratory Manager

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Phone: (02)9756 2166 | Email: enquiries@stsgeo.com.au

GEOTECHNICS PTY LTD
CONSULTING GEOTECHNICAL ENGINEERS

Dynamic Cone Penetrometer Test Report

Project: 38-44 JOHN T BELL DRIVE & 31-35 MATFEN CLOSE, MARYLAND
Client: NSW LAND & HOUSING CORPORATION C/- SMEC AUSTRALIA
Address: 20 Berry Street, North Sydney
Test Method: AS 1289.6.3.2

Project No.: 30615/4133D
Report No.: 20/3519
Report Date: 12/10/2020
Page: 2 of 2

NATA
Accredited for compliance with ISO/IEC 17025 - Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards
NATA Accreditation Number 2750

Site No.	P7	P8	P9			
Location	Refer to Drawing No. 20/3519	Refer to Drawing No. 20/3519	Refer to Drawing No. 20/3519			
Date Tested	1/10/2020	1/10/2020	1/10/2020			
Starting Level	Surface Level	Surface Level	Surface Level			
Depth (m)	Penetration Resistance (blows / 150mm)					
0.00 - 0.15	1	1	1			
0.15 - 0.30	2	2	2			
0.30 - 0.45	3	4	4			
0.45 - 0.60	3	3	3			
0.60 - 0.75	4	4	3			
0.75 - 0.90	5	6	4			
0.90 - 1.05	4	6	5			
1.05 - 1.20	3	7	6			
1.20 - 1.35	3	6	6			
1.35 - 1.50	3	5	5			
1.50 - 1.65	4	4	4			
1.65 - 1.80	6	4	4			
1.80 - 1.95	8	4	4			
1.95 - 2.10	8	6	5			
2.10 - 2.25	10	6	8			
2.25 - 2.40	12	7	9			
2.40 - 2.55	15	9	10			
2.55 - 2.70	22	10	11			
2.70 - 2.85	Refusal	10	12			
2.85 - 3.00		10	13			
3.00 - 3.15		Discontinued	Discontinued			
3.15 - 3.30						
3.30 - 3.45						
3.45 - 3.60						
3.60 - 3.75						

Remarks: * Pre drilled prior to testing

Approved Signatory.....
Orlando Mendoza - Laboratory Manager

Technician: JK

E1. CLASSIFICATION OF SOILS

E1.1 Soil Classification and the Unified System

An assessment of the site conditions usually includes an appraisal of the data available by combining values of engineering properties obtained by the site investigation with descriptions, from visual observation of the materials present on site.

The system used by STS Geotechnics Pty Ltd (STS) in the identification of soil is the Unified Soil Classification system (USC) which was developed by the US Army Corps of Engineers during World War II and has since gained international acceptance and has been adopted in its metricated form by the Standards Association of Australia.

The Australian Site Investigation Code (AS1726-1981, Appendix D) recommends that the description of a soil includes the USC group symbols which are an integral component of the system.

The soil description should contain the following information in order:

Soil composition

- SOIL NAME and USC classification symbol (IN BLOCK LETTERS)
- plasticity or particle characteristics
- colour
- secondary and minor constituents (name estimated proportion, plasticity or particle characteristics, colour

Soil condition

- moisture condition
- consistency or density index

Soil structure

- structure (zoning, defects, cementing)

Soil origin

interpretation based on observation eg FILL, TOPSOIL, RESIDUAL, ALLUVIUM.

E1.2 Soil Composition

(a) Soil Name and Classification Symbol

The USC system is summarised in Figure E1.2.1. The primary division separates soil types on the basis of particle size into:

- Coarse grained soils - more than 50% of the material less than 60 mm is larger than 0.06 mm (60 µm).

- Fine grained soils - more than 50% of the material less than 60 mm is smaller than 0.06 mm (60 µm).

Initial classification is by particle size as shown in Table E1.2.1. Further classification of fine grained soils is based on plasticity.

TABLE E1.2.1 - CLASSIFICATION BY PARTICLE SIZE

NAME	SUB-DIVISION	SIZE
Clay (1)		< 2 µm
Silt (2)		2 µm to 60 µm
Sand	Fine Medium Coarse	60 µm to 200 µm 200 µm to 600 µm 600 µm to 2 mm
Gravel (3)	Fine Medium Coarse	2 mm to 6 mm 6 mm to 20 mm 20 mm to 60 mm
Cobbles (3)		60 mm to 200 mm
Boulders (3)		> 200 mm

Where a soil contains an appropriate amount of secondary material, the name includes each of the secondary components (greater than 12%) in increasing order of significance, eg sandy silty clay.

Minor components of a soil are included in the description by means of the terms “some” and “trace” as defined in Table E1.2.2.

TABLE E1.2.2 - MINOR SOIL COMPONENTS

TERM	DESCRIPTION	APPROXIMATE PROPORTION (%)
Trace	presence just detectable, little or no influence on soil properties	0-5
Some	presence easily detectable, little influence on soil properties	5-12

The USC group symbols should be included with each soil description as shown in Table E1.2.3

TABLE E1.2.3 - SOIL GROUP SYMBOLS

SOIL TYPE	PREFIX
Gravel	G
Sand	S
Silt	M
Clay	C
Organic	O
Peat	Pt

The group symbols are combined with qualifiers which indicate grading, plasticity or secondary components as shown on Table E1.2.4

TABLE E1.2.4 - SOIL GROUP QUALIFIERS

SUBGROUP	SUFFIX
Well graded	W
Poorly Graded	P
Silty	M
Clayey	C
Liquid Limit <50% - low to medium plasticity	L
Liquid Limit >50% - medium to high plasticity	H

(b) Grading

"Well graded" Good representation of all particle sizes from the largest to the smallest.

"Poorly graded" One or more intermediate sizes poorly represented

"Gap graded" One or more intermediate sizes absent

"Uniformly graded" Essentially single size material.

(c) Particle shape and texture

The shape and surface texture of the coarse grained particles should be described.

Angularity may be expressed as "rounded", "sub-rounded", "sub-angular" or "angular".

Particle **form** can be "equidimensional", "flat" or elongate".

Surface texture can be "glassy", "smooth", "rough", pitted" or striated".

(d) Colour

The colour of the soil should be described in the moist condition using simple terms such as:

Black White Grey Red
Brown Orange Yellow Green
Blue

These may be modified as necessary by "light" or "dark". Borderline colours may be described as a combination of two colours, eg red-brown.

For soils that contain more than one colour terms such as:

- Speckled Very small (<10 mm dia) patches
- Mottled Irregular
- Blotched Large irregular (>75 mm dia)
- Streaked Randomly oriented streaks

(e) Minor Components

Secondary and minor components should be individually described in a similar manner to the dominant component.

*E1.3 **S**oil Condition*

(a) Moisture

Soil moisture condition is described as "dry", "moist" or "wet".

The moisture categories are defined as:
Dry (D) - Little or no moisture evident. Soils are running.
Moist (M) - Darkened in colour with cool feel. Granular soil particles tend to adhere. No free water evident upon remoulding of cohesive soils.

In addition the moisture content of cohesive soils can be estimated in relation to their liquid or plastic limit.

(b) Consistency

Estimates of the consistency of a clay or silt soil may be made from manual examination, hand penetrometer test, SPT results or from laboratory tests to determine undrained shear or unconfined compressive strengths. The classification of consistency is defined in Table E1.3.1.

TABLE E1.3.1 - CONSISTENCY OF FINE-GRAINED SOILS

TERM	UNCONFINED STRENGTH (kPa)	FIELD IDENTIFICATION
Very Soft	<25	Easily penetrated by fist. Sample exudes between fingers when squeezed in the fist.
Soft	25 - 50	Easily moulded in fingers. Easily penetrated 50 mm by thumb.
Firm	50 - 100	Can be moulded by strong pressure in the fingers. Penetrated only with great effort.
Stiff	100 - 200	Cannot be moulded in fingers. Indented by thumb but penetrated only with great effort.
Very Stiff	200 - 400	Very tough. Difficult to cut with knife. Readily indented with thumb nail.
Hard	>400	Brittle, can just be scratched with thumb nail. Tends to break into fragments.

Unconfined compressive strength as derived by a hand penetrometer can be taken as approximately double the undrained shear strength ($q_u = 2\ c_u$).

(c) Density Index

The insitu density index of granular soils can be assessed from the results of SPT or cone penetrometer tests. Density index should not be estimated visually.

TABLE E1.3.2 - DENSITY OF GRANULAR SOILS

TERM	SPT N VALUE	STATIC CONE VALUE q_c (MPa)	DENSITY INDEX (%)
Very Loose	0 - 3	0 - 2	0 - 15
Loose	3 - 8	2 - 5	15 - 35
Medium Dense	8 - 25	5 - 15	35 - 65
Dense	25 - 42	15 - 20	65 - 85
Very Dense	>42	>20	>85

E1.4 Soil Structure

(a) Zoning

A sample may consist of several zones differing in colour, grain size or other properties. Terms to classify these zones are:

Layer - continuous across exposure or sample
Lens - discontinuous with lenticular shape
Pocket - irregular inclusion
Each zone should be described, their distinguishing features, and the nature of the interzone boundaries.

(b) Defects

Defects which are present in the sample can include:

- fissures
- roots (containing organic matter)
- tubes (hollow)
- casts (infilled)

Defects should be described giving details of dimensions and frequency. Fissure orientation, planarity, surface condition and infilling should be noted. If there is a tendency to break into blocks, block dimensions should be recorded

E1.5 Soil Origin

Information which may be interpretative but which may contribute to the usefulness of the material description should be included. The most common interpreted feature is the origin of the soil. The assessment of the probable origin is based on the soil material description, soil structure and its relationship to other soil and rock materials.

Common terms used are:

“Residual Soil” - Material which appears to have been derived by weathering from the underlying rock. There is no evidence of transport.

“Colluvium” - Material which appears to have been transported from its original location. The method of movement is usually the combination of gravity and erosion.

“Landslide Debris” - An extreme form of colluvium where the soil has been transported by mass movement. The material is obviously distributed and contains distinct defects related to the slope failure.

“Alluvium” - Material which has been transported essentially by water. usually associated with former stream activity.

“Fill” - Material which has been transported and placed by man. This can range from natural soils which have been placed in a controlled manner in engineering construction to dumped waste material. A description of the constituents should include an assessment of the method of placement.

E1.6 Fine Grained Soils

The physical properties of fine grained soils are dominated by silts and clays.

The definition of clay and silt soils is governed by their Atterberg Limits. Clay soils are characterised by the properties of cohesion and plasticity with cohesion defines as the ability to deform without rupture. Silts exhibit cohesion but have low plasticity or are non-plastic.

The field characteristics of clay soils include:

- dry lumps have appreciable dry strength and cannot be powdered
- volume changes occur with moisture content variation
- feels smooth when moist with a greasy appearance when cut.

The field characteristics of silt soils include:

- dry lumps have negligible dry strength and can be powdered easily
- dilatancy - an increase in volume due to shearing - is indicted by the presence of a shiny film of water after a hand sample is shaken. The water disappears upon remoulding. Very fine grained sands may also exhibit dilatancy.
- low plasticity index
- feels gritty to the teeth

E1.7 Organic Soils

Organic soils are distinguished from other soils by their appreciable content of vegetable matter, usually derived from plant remains.

The soil usually has a distinctive smell and low bulk density.

The USC system uses the symbol Pt for partly decomposed organic material. The O symbol is combined with suffixes “O” or “H” depending on plasticity.

Where roots or root fibres are present their frequency and the depth to which they are encountered should be recorded. The presence of roots or root fibres does not necessarily mean the material is an “organic material” by classification.

Coal and lignite should be described as such and not simply as organic matter.

APPENDIX B – LABORATORY TEST RESULTS

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES2034713**	Page	: 1 of 13
Client	: **STS Geotechnics**	Laboratory	: Environmental Division Sydney
Contact	: ENQUIRES STS	Contact	: Customer Services ES
Address	: Unit 14/1 Cowpasture Place Wetherill Park 2164	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: 30055/30060/30614/30615/30616	Date Samples Received	: 02-Oct-2020 14:00
Order number	: E-2020-0389	Date Analysis Commenced	: 06-Oct-2020
C-O-C number	: ----	Issue Date	: 12-Oct-2020 18:55
Sampler	: MB/JK		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 33		
No. of samples analysed	: 33		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ASS: EA029 (SPOCAS): Laboratory determinations of ANC needs to be corroborated by effectiveness of the measured ANC in relation to incubation ANC. Unless corroborated, the results of ANC testing should be discounted when determining Net Acidity for comparison with action criteria, or for the determination of the acidity hazard and required liming amounts.
- ASS: EA029 (SPOCAS): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime ($CaCO_3$) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from kg/t dry weight to kg/m3 in-situ soil, multiply reported results x wet bulk density of soil in t/m3.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	30055/7020	30055/7025	30055/7026	30060/1280	30060/1281
				Client sampling date / time	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00
Compound	CAS Number	LOR	Unit		ES2034713-001	ES2034713-002	ES2034713-003	ES2034713-004	ES2034713-005
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		**5.9**	**7.4**	**7.0**	**7.3**	**7.3**
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		**29**	**319**	**122**	**50**	**178**
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	0.1	%		**15.0**	**11.9**	**15.2**	**18.7**	**11.2**
ED040S : Soluble Sulfate by ICPAES									
Sulfate as SO4 2-	14808-79-8	10	mg/kg		**10**	**30**	**30**	**10**	<10

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	30060/1282	30060/1283	30060/1288	30060/1289	30614/S1
			Client sampling date / time	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	30-Sep-2020 00:00
Compound	CAS Number	LOR	Unit	ES2034713-006	ES2034713-007	ES2034713-008	ES2034713-009	ES2034713-010
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**6.2**	**6.1**	**5.4**	**5.9**	**5.6**
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**20**	**17**	**76**	**47**	**30**
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	**4.5**	**5.2**	**18.7**	**9.1**	**19.1**
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	<10	**20**	<10	<10
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**----**	**----**	**----**	**----**	**30**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	30614/S2	30615/S1	30615/S2	30615/S3	30615/S4
			Client sampling date / time	30-Sep-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00
Compound	CAS Number	LOR	Unit	ES2034713-011	ES2034713-012	ES2034713-013	ES2034713-014	ES2034713-015
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**5.6**	**5.1**	**5.5**	**5.6**	**5.7**
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**48**	**295**	**145**	**388**	**82**
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	**25.9**	**19.1**	**17.7**	**16.9**	**19.4**
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**20**	**180**	**90**	**360**	**30**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**20**	**190**	**60**	**240**	**40**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	30615/S5	30615/S6	30615/S7	30615/ASS1	30615/ASS2
			Client sampling date / time	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00
Compound	CAS Number	LOR	Unit	ES2034713-016	ES2034713-017	ES2034713-018	ES2034713-019	ES2034713-020
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	5.8	7.3	6.3	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	162	54	51	----	----
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	----	----	----	4.2	5.8
pH OX (23B)	----	0.1	pH Unit	----	----	----	4.3	7.0
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	----	----	----	58	<2
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	----	----	----	101	<2
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	----	----	----	43	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S	----	----	----	0.093	<0.020
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	----	----	----	0.162	<0.020
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	----	----	----	0.068	<0.020
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.020	% S	----	----	----	0.039	0.033
Peroxide Sulfur (23De)	----	0.020	% S	----	----	----	0.052	0.035
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	----	----	----	<0.020	<0.020
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	----	----	----	<10	<10
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	----	----	----	0.062	0.033
Peroxide Calcium (23Wh)	----	0.020	% Ca	----	----	----	0.062	0.033
Acid Reacted Calcium (23X)	----	0.020	% Ca	----	----	----	<0.020	<0.020
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	----	----	----	<10	<10
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	----	----	----	<0.020	<0.020
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	----	----	----	0.158	0.212
Peroxide Magnesium (23Tm)	----	0.020	% Mg	----	----	----	0.160	0.212
Acid Reacted Magnesium (23U)	----	0.020	% Mg	----	----	----	<0.020	<0.020
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	----	----	----	<10	<10
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	----	----	----	<0.020	<0.020
EA029-F: Excess Acid Neutralising Capacity								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	30615/S5	30615/S6	30615/S7	30615/ASS1	30615/ASS2
				Client sampling date / time	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00
Compound	CAS Number	LOR	Unit		ES2034713-016	ES2034713-017	ES2034713-018	ES2034713-019	ES2034713-020
					Result	Result	Result	Result	Result
EA029-F: Excess Acid Neutralising Capacity - Continued									
Excess Acid Neutralising Capacity (23Q)	----	0.020	% CaCO3		----	----	----	----	**0.207**
acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t		----	----	----	----	**41**
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.020	% S		----	----	----	----	**0.066**
EA029-G: Retained Acidity									
HCl Extractable Sulfur (20Be)	----	0.020	% S		----	----	----	**0.046**	----
Net Acid Soluble Sulfur (20Je)	----	0.020	% S		----	----	----	<0.020	----
acidity - Net Acid Soluble Sulfur (a-20J)	----	10	mole H+ / t		----	----	----	<10	----
sulfidic - Net Acid Soluble Sulfur (s-20J)	----	0.020	% pyrite S		----	----	----	<0.020	----
EA029-H: Acid Base Accounting									
ANC Fineness Factor	----	0.5	-		----	----	----	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S		----	----	----	**0.11**	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t		----	----	----	**70**	<10
Liming Rate	----	1	kg CaCO3/t		----	----	----	**5**	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S		----	----	----	**0.11**	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t		----	----	----	**70**	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t		----	----	----	**5**	<1
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	0.1	%		**18.9**	**11.6**	**18.6**	----	----
ED040S : Soluble Sulfate by ICPAES									
Sulfate as SO4 2-	14808-79-8	10	mg/kg		**40**	<10	**10**	----	----
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	10	mg/kg		**140**	**20**	**20**	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	30615/ASS3	30615/ASS4	30615/ASS5	30615/ASS6	30615/ASS7
			Client sampling date / time	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00
Compound	CAS Number	LOR	Unit	ES2034713-021	ES2034713-022	ES2034713-023	ES2034713-024	ES2034713-025
				Result	Result	Result	Result	Result
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	4.6	4.5	4.0	4.8	4.7
pH OX (23B)	----	0.1	pH Unit	4.1	4.5	4.1	4.6	4.3
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	25	48	120	10	24
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	100	136	180	11	91
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	75	88	60	<2	68
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S	0.040	0.077	0.192	<0.020	0.038
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	0.161	0.218	0.289	<0.020	0.146
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	0.121	0.141	0.096	<0.020	0.108
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.020	% S	0.032	<0.020	0.031	<0.020	0.028
Peroxide Sulfur (23De)	----	0.020	% S	0.063	0.048	0.050	<0.020	0.044
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	0.031	0.048	<0.020	<0.020	<0.020
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	20	30	12	<10	<10
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	0.037	<0.020	<0.020	0.129	0.022
Peroxide Calcium (23Wh)	----	0.020	% Ca	0.037	<0.020	<0.020	0.129	0.025
Acid Reacted Calcium (23X)	----	0.020	% Ca	<0.020	<0.020	<0.020	<0.020	<0.020
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	<10	<10	<10	<10
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	<0.020	<0.020	<0.020	<0.020	<0.020
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	0.165	0.071	0.083	0.182	0.107
Peroxide Magnesium (23Tm)	----	0.020	% Mg	0.165	0.075	0.087	0.182	0.108
Acid Reacted Magnesium (23U)	----	0.020	% Mg	<0.020	<0.020	<0.020	<0.020	<0.020
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	<10	<10	<10	<10
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	<0.020	<0.020	<0.020	<0.020	<0.020
EA029-G: Retained Acidity								
HCl Extractable Sulfur (20Be)	----	0.020	% S	----	----	0.042	----	----
Net Acid Soluble Sulfur (20Je)	----	0.020	% S	----	----	<0.020	----	----
acidity - Net Acid Soluble Sulfur (a-20J)	----	10	mole H+ / t	----	----	<10	----	----
sulfidic - Net Acid Soluble Sulfur (s-20J)	----	0.020	% pyrite S	----	----	<0.020	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	30615/ASS3	30615/ASS4	30615/ASS5	30615/ASS6	30615/ASS7
				Client sampling date / time	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00
Compound	CAS Number	LOR	Unit		ES2034713-021	ES2034713-022	ES2034713-023	ES2034713-024	ES2034713-025
					Result	Result	Result	Result	Result
EA029-H: Acid Base Accounting									
ANC Fineness Factor	----	0.5	-		**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S		**0.07**	**0.12**	**0.22**	**0.02**	**0.05**
Net Acidity (acidity units)	----	10	mole H+ / t		**45**	**78**	**137**	**10**	**33**
Liming Rate	----	1	kg CaCO3/t		**3**	**6**	**10**	**1**	**2**
Net Acidity excluding ANC (sulfur units)	----	0.02	% S		**0.07**	**0.12**	**0.22**	**0.02**	**0.05**
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t		**45**	**78**	**137**	**10**	**33**
Liming Rate excluding ANC	----	1	kg CaCO3/t		**3**	**6**	**10**	**1**	**2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	30615/ASS8	30616/S1	30616/S2	30616/S3	30616/ASS1
			Client sampling date / time	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00
Compound	CAS Number	LOR	Unit	ES2034713-026	ES2034713-027	ES2034713-028	ES2034713-029	ES2034713-030
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**----**	**5.5**	**6.0**	**6.1**	**----**
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**----**	**41**	**32**	**27**	**----**
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	**5.2**	**----**	**----**	**----**	**5.2**
pH OX (23B)	----	0.1	pH Unit	**4.9**	**----**	**----**	**----**	**3.8**
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	**10**	**----**	**----**	**----**	**10**
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	**42**	**----**	**----**	**----**	**15**
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	**31**	**----**	**----**	**----**	**5**
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S	<0.020	**----**	**----**	**----**	<0.020
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	**0.067**	**----**	**----**	**----**	**0.024**
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	**0.050**	**----**	**----**	**----**	<0.020
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.020	% S	<0.020	**----**	**----**	**----**	<0.020
Peroxide Sulfur (23De)	----	0.020	% S	**0.051**	**----**	**----**	**----**	**0.025**
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	**0.051**	**----**	**----**	**----**	**0.025**
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	**32**	**----**	**----**	**----**	**16**
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	**0.053**	**----**	**----**	**----**	**0.123**
Peroxide Calcium (23Wh)	----	0.020	% Ca	**0.064**	**----**	**----**	**----**	**0.123**
Acid Reacted Calcium (23X)	----	0.020	% Ca	<0.020	**----**	**----**	**----**	<0.020
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	**----**	**----**	**----**	<10
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	<0.020	**----**	**----**	**----**	<0.020
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	**0.066**	**----**	**----**	**----**	**0.049**
Peroxide Magnesium (23Tm)	----	0.020	% Mg	**0.068**	**----**	**----**	**----**	**0.049**
Acid Reacted Magnesium (23U)	----	0.020	% Mg	<0.020	**----**	**----**	**----**	<0.020
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	**----**	**----**	**----**	<10
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	<0.020	**----**	**----**	**----**	<0.020
EA029-H: Acid Base Accounting								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	30615/ASS8	30616/S1	30616/S2	30616/S3	30616/ASS1
				Client sampling date / time	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00
Compound	CAS Number	LOR	Unit		ES2034713-026	ES2034713-027	ES2034713-028	ES2034713-029	ES2034713-030
					Result	Result	Result	Result	Result
EA029-H: Acid Base Accounting - Continued									
ANC Fineness Factor	----	0.5	-		1.5	----	----	----	1.5
Net Acidity (sulfur units)	----	0.02	% S		0.07	----	----	----	0.04
Net Acidity (acidity units)	----	10	mole H+ / t		42	----	----	----	26
Liming Rate	----	1	kg CaCO3/t		3	----	----	----	2
Net Acidity excluding ANC (sulfur units)	----	0.02	% S		0.07	----	----	----	0.04
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t		42	----	----	----	26
Liming Rate excluding ANC	----	1	kg CaCO3/t		3	----	----	----	2
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	0.1	%		----	14.6	8.6	8.0	----
ED040S : Soluble Sulfate by ICPAES									
Sulfate as SO4 2-	14808-79-8	10	mg/kg		----	20	<10	<10	----
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	10	mg/kg		----	20	<10	<10	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	30616/ASS2	30616/ASS3	30616/ASS4	----	----
			Client sampling date / time	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	----	----
Compound	CAS Number	LOR	Unit	ES2034713-031	ES2034713-032	ES2034713-033	--------	--------
				Result	Result	Result	----	----
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	**5.1**	**5.3**	**5.2**	----	----
pH OX (23B)	----	0.1	pH Unit	**5.0**	**4.6**	**5.5**	----	----
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	**9**	**4**	**5**	----	----
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	**10**	**4**	**7**	----	----
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	<2	<2	----	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S	<0.020	<0.020	<0.020	----	----
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	<0.020	<0.020	<0.020	----	----
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	<0.020	<0.020	<0.020	----	----
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.020	% S	<0.020	<0.020	<0.020	----	----
Peroxide Sulfur (23De)	----	0.020	% S	<0.020	<0.020	<0.020	----	----
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	<0.020	<0.020	<0.020	----	----
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	<10	<10	----	----
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	**0.047**	**0.098**	<0.020	----	----
Peroxide Calcium (23Wh)	----	0.020	% Ca	**0.047**	**0.098**	<0.020	----	----
Acid Reacted Calcium (23X)	----	0.020	% Ca	<0.020	<0.020	<0.020	----	----
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	<10	<10	----	----
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	<0.020	<0.020	<0.020	----	----
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	**0.062**	**0.037**	**0.111**	----	----
Peroxide Magnesium (23Tm)	----	0.020	% Mg	**0.063**	**0.039**	**0.113**	----	----
Acid Reacted Magnesium (23U)	----	0.020	% Mg	<0.020	<0.020	<0.020	----	----
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	<10	<10	----	----
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	<0.020	<0.020	<0.020	----	----
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	----	----
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	----	----
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	----	----
Liming Rate	----	1	kg CaCO3/t	**1**	<1	<1	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	30616/ASS2	30616/ASS3	30616/ASS4	----	----
				Client sampling date / time	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	----	----
Compound	CAS Number	LOR	Unit		ES2034713-031	ES2034713-032	ES2034713-033	--------	--------
					Result	Result	Result	----	----
EA029-H: Acid Base Accounting - Continued									
Net Acidity excluding ANC (sulfur units)	----	0.02	% S		<0.02	<0.02	<0.02	----	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t		<10	<10	<10	----	----
Liming Rate excluding ANC	----	1	kg CaCO3/t		**1**	<1	<1	----	----